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CASE REPORT

Sting-ray injuries to the hand: case report, literature review and a suggested algorithm for management

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Summary Sting-ray injuries have recently had high profile media coverage following a rare fatality. However, minor injuries to the hands and feet are common. We present a case of a sting-ray injury to the hand. This was washed out under local anaesthetic at the local emergency department and was a delayed presentation to a specialist hand surgeon, 1 month post injury with severe pain. Ultrasound scan showed synovitis of the palm, confirmed at synovectomy the following day, along with frankly necrotic lumbrical muscles. Histology showed extensive low grade chronic inflammation. At 1 month follow up the patient was pain free and making good progress with a full and functional range of movement.

We review the available literature and discuss the circumstances and pathophysiology of the sting-ray sting, the most appropriate first aid management, need for prompt surgical exploration and wound debridement and the possible complications. We would also like to suggest an algorithm for the management of sting-ray injuries to the hand.

Sting-rays are the most common group of fish involved in human envenomations[1] and have recently received a high media profile following a rare fatality.[2] Approximately 150 individual species have been identified worldwide, inhabiting the shallow, warm coastal waters from the tropics to temperate regions. They are bottom dwellers, lying submerged in the sand with only their eyes visible.[3]

Sting-ray injuries are common in Australasia, with over 200 cases presenting to emergency departments in Victoria, Australia over a 5-year period.[4] Injuries occur principally in the limbs following inadvertent disturbance of the ray by a swimmer or wader,[1] however puncture of the thoracic and abdominal cavities have been described.[5,6] If provoked, sting-rays respond in defence by whipping their muscular

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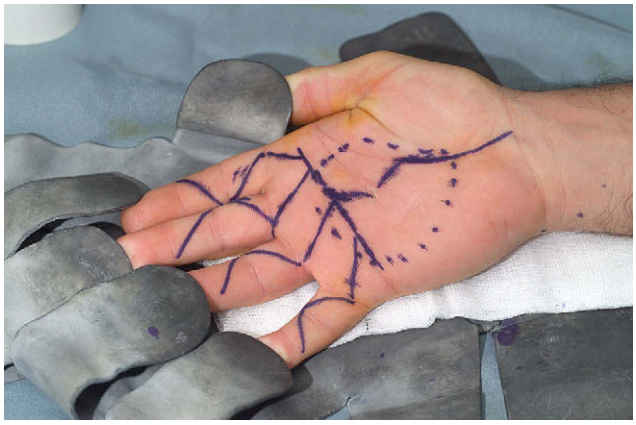

Figure 1 Pre-operative skin markings highlighting the palpable fibrosis centred around the healed visible puncture wound in the centre of the proximal palmar crease.

tail upwards in front of them, which have up to four serrated, barbed spines. The spines are driven into the victim, often remaining in situ. An integument over the spine is ruptured, releasing the venom into the wound.[7] The venom is a heat labile, water soluble protein with a molecular weight >100 000 Da. It has an intravenous median lethal dose of 28 mg/kg body weight. Local effects include vasoconstriction and severe pain, out of proportion to apparent injury,[7] with localised necrosis and inflammation in the long term. Systemic features of envenomation include bradycardia, atrioventricular heart block and cardiac ischaemia.[3]

Case report

A 49-year-old male presented to the plastic surgery unit via the emergency department, with severe pain and swelling to the palm of his dominant (right) hand and limitation of function. On questioning, it emerged that he had sustained a sting-ray injury to his hand 1 month previously, and was otherwise well. The injury was from a sting-ray encountered whilst swimming in the sea whilst on holiday in Cuba. The exact species was unknown. On prompt attendance at the local Cuban emergency department, the wound was explored under local anaesthetic, and no foreign body was found. The wound was treated conservatively, and healed by second intention. A 7 day course of oral antibiotics was administered. On examination, the patient's palm was swollen and extension was limited in the middle and ring fingers, particularly at the proximal interphalangeal joints. At this time, although having never complained of paraesthesia, he had a positive Phalen's test and Tinnel's test over his carpal tunnel. An urgent ultrasound scan showed synovitis of the palm and wrist. Exploration and synovectomy was performed the following day under general anaesthetic with a tourniquet. Intraoperative examination revealed palpable fibrosis centred around the puncture wound in the centre of the proximal palmar crease (Figure 1). Intraoperatively, he was found to have gross fibrosis and synovitis of the palm, with sparing of the digits. The lumbricals to the middle and ring fingers, and the volar part of

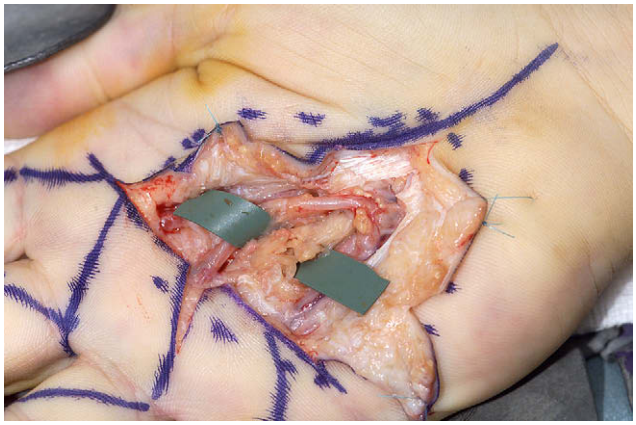

Figure 2 Isolated necrotic lumbricals and volar part of the 3rd palmar interrosseus muscle prior to excision.

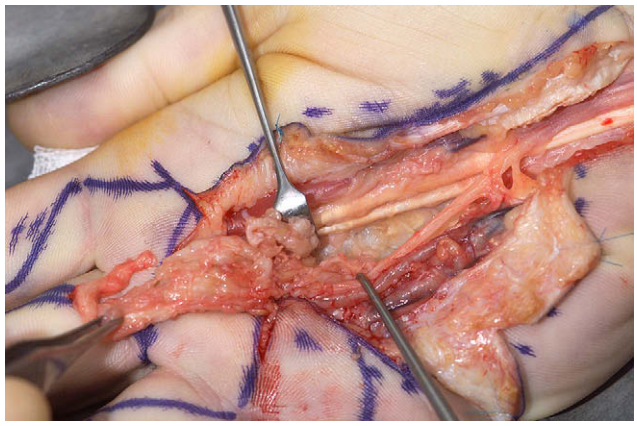

Figure 3 Careful mobilisation of necrotic parts preserving neurovascular bundles in close proximity.

Figure 4 The excised specimen beside a ruler prior to histological examination.

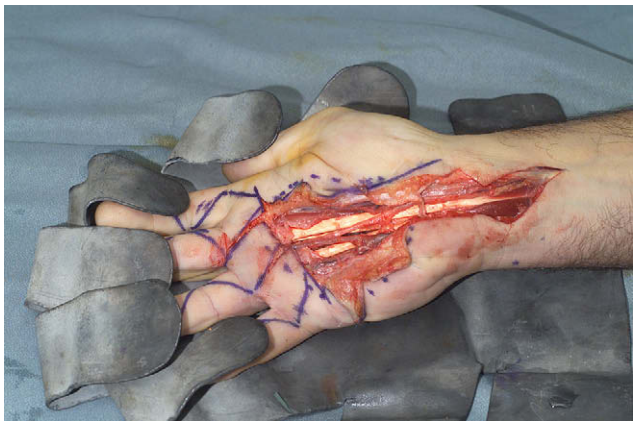

Figure 5 The extent of the wound following extensive synovectomy and debridement prior to definitive closure.

the 3rd palmar interosseus were frankly necrotic and excised (Figures 2—4). The dense synovitis extended proximally across all flexor tendons to the carpal tunnel and a synovectomy was performed. Despite thorough extensive exploration and debridement, no cartilagenous foreign body was found (Figure 5). The wound showed no evidence of infection and was closed primarily. Histopathological examination showed low grade extensive chronic inflammation and formation of necrobiotic-type granulomas. Occasional foreign body-type giant cells were noted and formation of granulation tissue was evident. Hyperplasia of synovial cells was also apparent. There were multiple areas of necrosis and signs of secondary fibrosis. Following our suggested algorithm for management (see Figure 6), at 11 month follow up, the wound had fully healed and the patient had attained a full range of movement (Figures 7—9).

Discussion

A number of options for first aid and definitive treatment have been described in the literature.[8] There are few clinical trials in this field. We found no case reports or reviews in the plastic surgery literature concerning such injuries. Here we will only discuss the management of soft tissue injuries to the hand, relevant to the hand and plastic surgeon.

After ensuring haemostasis, the principle first aid measure is irrigation, in an attempt to remove the venom and integument debris.[9] Irrigation with hot water (as hot as is tolerated) seems to provide the best immediate pain relief.[1,5,9] This pain-relieving effect is thought to be a result of the denaturation of the protein in the venom, however this was disputed by Meyer in 1997, who showed that the pain-producing properties of the protein were only deactivated at temperatures in excess of 50 °C. He suggests that this temperature is greater than that tolerated by humans.[7]

It has also been suggested that hot water irrigation may also reduce the incidence of localised necrosis.[10] Infiltration of the wound with local anaesthetic alleviates the pain further,[5,9,11] however, adrenaline should not be used as this will vasoconstrict and potentially worsen localised necrosis. Local nerve blocks may also be considered. Tetanus prophylaxis should be considered for all patients.[9] In the acute setting the patient should be monitored for at least 4 h post injury for the development of systemic toxicity.

If a retained foreign body is suspected, X-ray examination may be useful.[7] Whilst the spine is radio-opaque, negative X-ray and ultrasound scan does not rule out a retained foreign body, as the integument is rarely visible. Thorough wound exploration and debridement is necessary

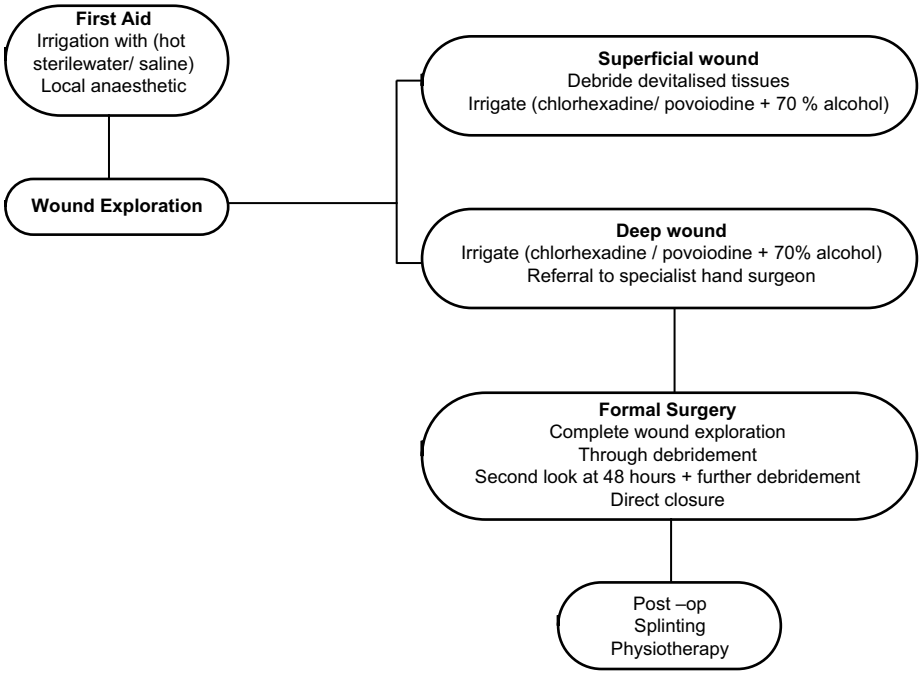

Figure 6 A suggested algorithm for the management of stingray injuries to the hand.

Figure 7

Figure 9

in all but the most superficial wounds.[9,11,12] In some species of sting-ray, the spines can measure up to 37 cm[6] and consequently the wound may extend deeper than expected. The wound should be fully explored and all necrotic or haemorrhagic tissue removed, along with any visible foreign bodies. This may involve extensive debridement of local soft tissues. Histopathological examination classically shows evidence of chronic inflammation.[9] Local fascial compartments should be released,[9,11] reducing the chance of compartment syndrome. In the acute setting, wounds should generally be left open and packed and reviewed at 48 h and closed if no further debridement is indicated. Injuries to the hands or wrists should be referred to a specialist hand surgeon to ensure adequate debridement. Where inadequate or no debridement is performed, the wound is unlikely to heal and may cause localised chronic pain and loss of function[9] such as in the case we describe.

Postoperative splinting to assist in soft tissue healing and physiotherapy are necessary to ensure maximal functional recovery.[11] Broad spectrum antibiotic therapy has been advocated by many[10,11] although the inflammatory reaction associated with these injuries is often aseptic. Hyperbaric oxygen therapy has also been suggested as an adjuvant treatment,[12] though the efficacy has not been proven.

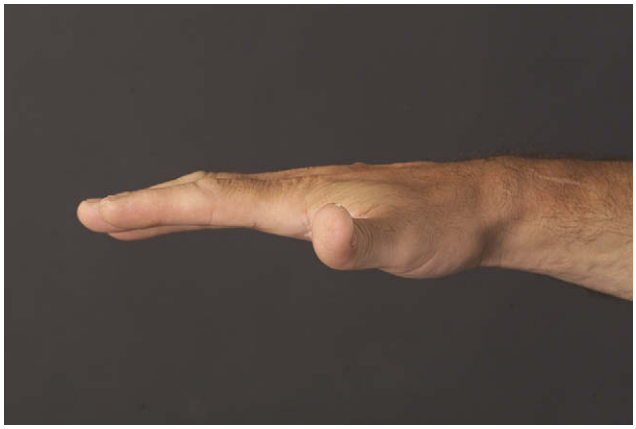

Figure 8

In conclusion, although common worldwide, sting-ray injuries are rarely seen in the UK. Nevertheless they have the potential to cause considerable morbidity and rarely mortality. Injuries to the hand can result in chronic severe pain, inflammatory reactions, non-healing wounds and considerable loss of function. Whilst appropriate first aid may be carried out at the time of injury, prompt surgical exploration and adequate debridement is unlikely to be attempted in the emergency department for fear of iatrogenic injury. These patients may develop long term sequelae. On return to the UK, immediate referral to a specialist hand surgeon for definitive treatment may help prevent this.

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